

Technical Report 1188

**Videogame-Based Training Success:
The Impact of Trainee Characteristics – Year 2**

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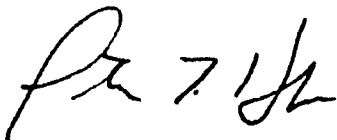
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FOREWORD

The U.S. Army Research Institute for the Behavioral and Social Sciences (ARI), as part of its Training for Interactive Distributed Environments work package, is investigating the use of training technology that is effective, affordable, and distributable. ARI seeks to provide the Army with guidance on how game-based training tools can be used for military training.

The current research effort was a follow-up investigation to assess how trainee characteristics impact training outcomes in a game-based training environment. The game used for this research was *America's Army*. *America's Army* was developed by the Office of Economic and Manpower Analysis to serve as an interactive tool for providing potential recruits with information regarding U.S. Army opportunities. In March 2005, *America's Army* was used during a four-day training exercise at the U. S. Military Academy. This game was used to further develop cadet tactics skills and was chosen because of its ability to allow for the virtual simulation of small team maneuvers.

An initial summary of this research was briefed to representatives from the Training and Doctrine Command—Training Development and Analysis Directorate; the Research, Development, Experimentation Command/Simulation and Training Technology Center; the Army Research Lab – Human Research & Engineering Directorate; and the Institute for Creative Technologies in September 2005. Portions of the findings from this research were also presented at the 21st Annual Conference of the Society for Industrial/Organizational Psychology in May 2006, the Serious Games Summit in October 2005, and I/ITSEC in December 2005.



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VIDEOGAME-BASED TRAINING SUCCESS: THE IMPACT OF TRAINEE CHARACTERISTICS – YEAR 2

EXECUTIVE SUMMARY

Research Requirement:

Personal Computer (PC)-based videogames are emerging as an increasingly popular training tool in the U. S. Army. The present research represents a follow-up investigation to Orvis, Orvis, Belanich, and Mullin (2005) with regards to the impact of trainee characteristics in videogame-based training environments. Specifically, this follow-up research examines prior videogame experience, videogame self-efficacy, and goal orientation as antecedents that maximize trainee motivation, as well as other learner choices and outcomes, in PC game-based training.

Procedure:

In this research, participants played *America's Army*, a first-person-perspective videogame as part of a tactics training exercise. The videogame began with a single-player section to introduce game-specific tasks, followed by a multi-player section where participants formed small teams to conduct several collaborative missions. Prior to and after the training exercise, cadets were asked to complete online questionnaires. 364 cadets completed the pretraining questionnaire, which assessed trainee characteristics, such as videogame experience and goal orientation, and pretraining motivation. 80 of the 364 cadets completed the posttraining questionnaire, which assessed several learner outcomes/choices, such as trainee satisfaction with the training experience and time spent engaging in the training game.

Findings:

Results demonstrate that these trainee characteristics, as a set, had a positive impact on trainee motivation, trainee satisfaction with the training experience, ease in using the training game interface, team cohesion, metacognitive strategies utilized during training, and time spent engaging in the training game. Further, consistent with Year 1 of this research initiative, the present results suggest that prior videogame experience positively predicted these criteria only when trainees' prior experience was with videogames possessing similar characteristics as the current training game. Results also parallel our Year 1 findings in that 60% of the military participants in this sample reported they had limited or no prior experience playing videogames.

Utilization and Dissemination of Findings:

The results of this research provide useful information to training game developers and instructors using videogames as training tools. This research extends our Year 1 findings, as well as other prior work, by demonstrating that a trainee's prior experience, self-efficacy, and goal orientation beliefs uniquely contribute to understanding when game-based training should succeed in enhancing trainee motivation and other important learner choices/outcomes. Modification of these trainee characteristics prior to training may help to enhance the effectiveness of PC game-based training.

VIDEOGAME-BASED TRAINING SUCCESS: THE IMPACT OF TRAINEE CHARACTERISTICS – YEAR 2

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VIDEOGAME-BASED TRAINING SUCCESS: THE IMPACT OF TRAINEE CHARACTERISTICS – YEAR 2

INTRODUCTION

PC-based videogames are emerging as an increasingly popular training tool in the U. S. Army (Herz & Macedonia, 2002). One rationale for using game-based simulations for training purposes is that they can be motivating to use, and it is easier to train motivated learners than non-motivated learners (Malone, 1981; Prensky, 2001). Further, research demonstrates that increased trainee motivation, and hence time and effort devoted to training, subsequently improves learning outcomes such as knowledge/skill acquisition and retention (Colquitt, LePine, & Noe, 2000; Mathieu, Tannenbaum, & Salas, 1992; Tannenbaum & Yukl, 1992).

Unfortunately, research also suggests that in self-directed, technology-delivered training environments (such as e-learning and game-based training environments) trainees with low motivation sometimes terminate training before mastering the intended training objectives (Bell & Kozlowski, 2002; Steinberg, 1989; Tennyson, 1980). Such trainees are clearly at a disadvantage. Consequently, determining how to motivate trainees to continue engaging in game-based learning environments is of great concern to instructors and trainers.

Research on training games has primarily focused on videogame features (e.g., the training game's level of challenge, realism, and interactivity) that may influence trainee motivation and other training outcomes of game-based training environments. Indeed, such game features have been found to enhance a trainee's knowledge acquisition and motivation to learn (Belanich, Sibley, & Orvis, 2004; Corbeil, 1999; Garris, Ahlers, & Driskell, 2002). This prior research has enhanced our understanding of how to design the actual training game to improve its effectiveness. Yet, to date, little research has examined individual characteristics of the trainee that may facilitate or impede trainee motivation. The present research focuses on determining individual characteristics that maximize trainee motivation in game-based training environments.

According to social cognitive theory, individuals' cognitions and behaviors during a learning experience are influenced by two motivational constructs: a) self-efficacy – personal perceptions regarding one's ability to accomplish a given task and b) goals – one's reasons for engaging in the task (Bandura, 1986; Pintrich & Schunk, 1996). Traditional training and e-learning research has shown that self-efficacy and goal orientation are related to trainee motivation, time on task, and other training outcomes (e.g., Brown, 2001; Colquitt et al., 2000; Fisher & Ford, 1998). Prior research has also demonstrated that trainees' previous videogame experience is positively related to time on task in game-based training environments (Orvis et al., 2005). Thus, this paper focuses on self-efficacy, goal orientation, and prior videogame experience as antecedents of trainee motivation, as well as other learner choices and outcomes. The ability to identify such individual attributes that lead to success in PC game-based training environments will help to better prepare Soldiers for training and will lead to increased operational capabilities.

Trainee Motivation and Learner Choices/Outcomes Relevant to Game-Based Training

Pretraining motivation, also referred to as motivation to learn, reflects the trainee's desire to learn the content of the training program (Noe, 1986). Pretraining motivation is believed to prepare trainees to learn by heightening their receptiveness to new ideas, attention, and effortful behavior during the training experience (e.g., Mathieu et al., 1992). Indeed, research has consistently demonstrated that pretraining motivation predicts both cognitive and skill-based learning outcomes across a variety of settings (Baldwin, Magjuka, & Loher, 1991; Colquitt et al., 2000; Martocchio & Webster, 1992; Noe & Schmitt, 1986; Tannenbaum & Yukl, 1992).

In addition to pretraining motivation, the current research examines several additional criteria relevant to learning in videogame-based training environments. Research has found that individuals' learner choices during instruction (i.e., their choices concerning the level and focus of effort to expend) influence their level of learning in technology-delivered training environments (Brown, 2001; Schmidt & Ford, 2003). Learner choices are reflected both in an individual's cognitions (e.g., metacognitive activity, off-task attention) and behaviors (e.g., time on task, practice behaviors) during the learning experience (Brown, 2001). Prior research also demonstrates that affect-based outcomes (e.g., training satisfaction) are significantly related to learning in technology-delivered training environments (e.g., Wasserman, Orvis, Fisher, & Barry, 2002), and that individuals' performance within a training program is predictive of knowledge/skill transfer (Ford et al., 1998; Kozlowski, Gully, Brown, Salas, Smith, & Nason, 2001). Thus, in addition to pretraining motivation, this research investigates six criteria relevant to videogame-based learning: the learner choices of (1) metacognitive activity and (2) time on task; the affect-based outcomes of (3) training satisfaction, (4) ease in using the training game's user interface, and (5) perceived cohesion with one's teammates while playing the game; and the skill-based outcome – (6) training performance.

Metacognitive activity. Metacognition involves planning, monitoring, and revising goal appropriate behavior (Brown, Bransford, Ferrara, & Campione, 1983). Learners who engage in greater metacognitive activity during training should learn more effectively because they actively monitor their learning progress, self-evaluate where they are having difficulties, and adjust their behaviors accordingly to address these difficulties (Brown et al., 1983; Ford, Smith, Weissbein, Gully, & Salas, 1998). Prior research supports that engagement in metacognitive activity during instruction results in higher knowledge and skill acquisition (Ford et al., 1998; Pintrich & DeGroot, 1990; Schmidt & Ford, 2003). Metacognition may be a particularly important learner choice in game-based training because this type of learning environment typically provides little external structure or feedback regarding the most effective way to learn while progressing through the training game.

Time on task. The length of time in which a learner is engaged in learning the knowledge or skills to be mastered during instruction has consistently been demonstrated to be an important predictor of learning in both educational and organizational learning contexts (e.g., Bloom, 1974; Bloom, 1976; Borg, 1980; Brown, 2001; Good & Beckerman, 1978). For example, Brown (2001) found that amount of time spent engaging in an e-learning training program was positively related to knowledge acquisition.

Training satisfaction. Training satisfaction focuses on both emotionally-based opinions concerning the training (e.g., the trainee liking the training) and reactions regarding the utility of the training (e.g., the trainee believing the training enhanced his/her knowledge or skills). Trainees' level of satisfaction with the training has been found to be significantly related to learning in an e-learning environment (Wasserman et al., 2002). This may be because when trainees are more satisfied with their training experiences, they are likely to stay engaged for longer periods of time or put forth greater mental effort in trying to learn the training content, thus resulting in greater levels of learning.

Ease in using game interface. The perception of ease in using the training game interface is another criterion that should influence the level of engagement in a videogame-based training environment. If technology-delivered learning environments are frustrating and difficult to use, trainees may experience decreased motivation and not fully engage in the instruction (Park & Tennyson, 1980; Tennyson, 1980). Difficulty with the technology or interface in which the instructional content is delivered has been cited as a key frustration source and a reason for low completion rates in e-learning programs (Frankola, 2001). Moreover, prior research has found that trainees' perceptions regarding the user interface of an e-learning program were positively related to their satisfaction with the overall training; which, in turn, was positively related to learning (Wasserman et al., 2002).

Team cohesion. Many training videogames are collaborative in nature, requiring the interaction and cooperation among trainee team members in order to be successful in the game and to learn the instructional content. Previous collaborative learning research has found that the quality of intra-team interactions is a key element in determining the extent and depth of learning in such environments (Gilbert & Moore, 1998; Northrup, 2001; Shute, Lajoie, & Gluck, 2000; Wagner, 1997). Quality team interactions originate, in part, from collaborative team states such as team cohesion. Indeed, team cohesion, most commonly defined as members liking for one another (Evans & Jarvis, 1980) and the extent to which team members are attracted to the idea of the group (Hogg, 1992), has been found to be directly related to group effectiveness (Evans & Dion, 1991; Mullen, Anthony, Salas, & Driskell, 1993; Mullen & Copper, 1994).

Training performance. An individual's performance while completing a training program is indicative of the extent to which he/she is acquiring the skills or knowledge being taught within the training. Further, prior training research demonstrates that a learner's training performance is positively related to knowledge/skill transfer (Ford et al., 1998; Kozlowski et al., 2001).

Prior Videogame Experience

To date, limited gaming research has attempted to identify trainee characteristics that influence learner choices/outcomes in videogame-based training environments. Prior research has found that an individual's prior videogame experience (i.e., frequency of game use) is predictive of his/her future performance in videogame-based environments (Gagnon, 1985; Young, Broach, & Farmer, 1997). Further, the *Year 1* results of the present research initiative demonstrate that a trainee's level of prior videogame experience predicts his/her learner choices during training and his/her subsequent affect-based learning outcomes; prior gaming experience

significantly predicted a trainee's time spent engaging in the training game, satisfaction with the training experience, perceived ease in using the training game interface, and team cohesion (Orvis et al., 2005).

Moreover, in *Year 1*, we also found that the influence of prior experience on these learner choices/outcomes was dependent on the *specificity* of a trainee's prior videogame experience. Specifically, prior game experiences that shared similar game characteristics to the given training game environment (e.g., pace, interface, perspective) were more likely to positively predict the learner choices/outcomes. Prior experiences with irrelevant games (i.e., games that do not share similar characteristics) did not predict these choices/outcomes. This finding has also been observed with respect to computer experience, in that specific prior computer experiences have been found to be differentially predictive of learning outcomes in computer-based learning environments (Salanova, Grau, Cifre, & Llorens, 2000; Woodrow, 1991).

Consistent with our *Year 1* findings, we expected in the current research that trainees with greater levels of overall videogame experience would be more motivated to train in the given videogame-based training environment than those with less videogame experience. Prior videogame experience was also expected to positively influence learner choices during training (i.e., metacognitive activity and time on task), subsequent affect-based learning outcomes (i.e., training satisfaction, ease in using game interface, and perceived team cohesion), and training performance. Further, we expected that only experience with *relevant* videogames (i.e., game types that share similar game characteristics to the given training game environment) would positively influence these training criteria.

Videogame Self-Efficacy

Self-efficacy is a judgment of one's capability to successfully perform a specific task (Bandura, 1977). Self-efficacy is a domain specific construct in that it varies across different types of tasks and situational contexts (Bandura, 1977). As such, of particular relevance to videogame-based training environments is *videogame self-efficacy* - a judgment of one's capability to successfully play videogames.

Trainee self-efficacy beliefs have been found to be an important predictor of pretraining motivation (Colquitt et al., 2000), amount of time spent practicing new skills (Bouffard-Bouchard, 1990), trainee reactions to a training program (Mathieu, Martineau, & Tannenbaum, 1993), and learning and performance (Bandura & Cervone, 1986; Colquitt et al., 2000; Gist, Schwoerer, & Rosen, 1989; Martocchio & Judge, 1997; Martocchio & Webster, 1992) in various training contexts, including technology-delivered training contexts. *Year 1* of this research initiative also demonstrated the positive impact of self-efficacy in videogame-based training environments. Specifically, we examined trainees' levels of computer self-efficacy and found that this type of self-efficacy provided incremental validity over prior videogame experience in the prediction of time spent engaging in the training, perceived ease in using the training interface, and team cohesion (Orvis et al., 2005).

In general, prior research suggests that individuals with high self-efficacy tend to exert greater mental effort and persistence while completing a training program; and thus, experience

more positive cognitive, skill, and affect-based learning outcomes. Thus, consistent with this prior work, we expected in the current research that trainees with greater videogame self-efficacy would be more motivated to train in a videogame-based training environment than those with lower videogame self-efficacy. Further, trainees' level of videogame self-efficacy was expected to positively influence their learner choices during training, subsequent affect-based learning outcomes, and training performance.

Goal Orientation

Goals are widely recognized as being central to the understanding of motivated behavior. Dispositional goal orientation theory suggests that individuals adopt distinct outlooks or mental frameworks regarding learning and achievement contexts (Brett & Vandewalle, 1999). These differing frameworks influence individuals' reasons for engaging in learning/achievement tasks, beliefs regarding causes of success, and preferences regarding task difficulty (Dweck, 1986; Farr, Hofmann, & Ringenbach, 1993). Thus, a trainees' goal orientation should influence his/her cognitions and behaviors during a learning experience. To the authors' knowledge, goal orientation has not been examined within the context of videogame-based training environments.

Learning goal orientation. Learning goal orientation is a dedication to developing competence by acquiring new skills, mastering novel situations, and learning from experience (Dweck, 1986; Dweck & Leggett, 1988; Vandewalle, 1997). Learning-oriented learners view ability and skills as malleable. They tend to seek out novel or challenging situations in order to increase their competence on a given task (Dweck, 1986; Kozlowski et al., 2001). As such, these individuals perceive training as an opportunity to learn, and they believe demonstrating effort and persistence, even in the face of difficulties, is worthwhile for increasing one's competence.

Prior research conducted on classroom and technology-delivered training has demonstrated that Learning goal orientation is positively related to learning (Fisher & Ford, 1998) and pretraining motivation (Colquitt & Simmering, 1998). Learning goal orientation has also been associated with positive effects on learner choices during training. Trainees who approach learning environments with the purpose of mastering new knowledge/skills engaged in greater metacognitive activity (Ford et al., 1998; Schmidt & Ford, 2003), reported decreases in their off-task attention (Brown, 2001), and demonstrated greater effort during training (Ames & Archer, 1988; Fisher & Ford, 1998). Further, prior research has demonstrated beneficial effects of Learning goal orientation on an individual's affective reactions (e.g., satisfaction with performance; Jagacinski & Nicholls, 1984; Treasure & Roberts, 1994).

Accordingly, we expected that trainees with high Learning goal orientation would be more motivated to train in a videogame-based training environment than those with lower levels of Learning goal orientation. Further, we expected Learning goal orientation to positively influence learner choices of metacognitive activity and time on task, the affect-based learning outcome of training satisfaction, and training performance.

Performance goal orientation. Individuals with high Performance goal orientation believe their ability and skill levels are stable and unlikely to change. Performance-oriented learners focus on demonstrating and validating their competence by seeking good performance

evaluations and avoiding negative ones (Dweck, 1986). These learners prefer learning environments that are familiar and do not require much effort to master (i.e., learning environments that ensure positive evaluations of their capabilities) because their concern with competence is more about superficial demonstration than substantive development (Campbell & Kuncel, 2001; Vandewalle, Cron, & Slocum, 2001). Accordingly, the desire for a positive evaluation regarding one's competency does not necessarily correspond with engaging in cognitions and behaviors needed to actually develop competence. In fact, performance-oriented learners may withdraw effort or avoid difficult learning tasks all together (Ames, 1992; Duda & Nicholls, 1992).

Initial research results for the influence of Performance goal orientation on learning/performance outcomes have tended to be inconsistent, sometimes exhibiting effects but often failing to do so (Beaubien & Payne, 1999). Much of this initial work was based on a two-factor model of goal orientation - Learning and Performance goal orientation (e.g., Button, Mathieu, & Zajac, 1996; Fisher & Ford, 1998; Ford et al., 1998). However, several researchers have suggested that goal orientation is better conceptualized as a three-factor construct, with Performance goal orientation consisting of two separate dimensions: Performance Avoid and Performance Prove (Vandewalle, 1997; Vandewalle et al., 2001). Elliot's (1994) meta-analysis, as well as other studies (e.g., Vandewalle & Cummings, 1997), has provided evidence that the Performance Avoid and Performance Prove dimensions of Performance goal orientation have differential relationships with various outcome variables. Accordingly, we will examine the independent effects of these two dimensions on the learner choices/outcomes, in addition to the effects of Learning goal orientation.

Performance Avoid goal orientation focuses on avoiding negation of one's competence, demonstrations of low ability/skill levels, and negative evaluations from others (Brett & Vandewalle, 1999; Vandewalle, 1997). Prior research has generally demonstrated that Performance Avoid goal orientation is associated with negative effects on learner choices during training and subsequent learning outcomes (Elliot & Harackiewicz, 1996; Ford et al., 1998; Schmidt & Ford, 2003; Vandewalle et al., 2001). For instance, Schmidt and Ford (2003) found that trainees with a higher Performance Avoid goal orientation engaged in less metacognitive activity during training. Metacognition involves actively monitoring for and evaluating/determining content areas in which one is having personal difficulties mastering. Individuals with high Performance Avoid goal orientation seek to avoid evaluations concerning personal areas in need of improvement, regardless of whether the evaluation is other- or self-generated; thus, they tend to avoid engagement in metacognitive activity. As another example, Elliot and Harackiewicz (1996) demonstrated that trainees in a high Performance Avoid goal orientation training group spent less time on task as compared to those in the high Learning goal orientation or Performance Prove orientation induced training groups.

In contrast, Performance Prove goal orientation focuses on demonstrating or proving one's competence by outperforming others and gaining favorable evaluations from others (Brett & Vandewalle, 1999; Vandewalle, 1997). The central difference between Performance Prove and Performance Avoid concerns whether one is primarily driven to outperform others or to avoid failure. Research is still inconclusive about the role of Performance Prove goal orientation. In general, Performance Prove goal orientation has failed to demonstrate a

consistent positive or negative relationship with any given learning criterion, including metacognitive activity, goal setting, post-training self-efficacy, knowledge acquisition, or skill-based learning (e.g., Schmidt & Ford, 2003; Vandewalle et al., 2001).

Based on this prior work, we expected that trainees with high Performance Avoid goal orientation would be less motivated to train in a videogame-based training environment than those with lower levels of Performance Avoid goal orientation. Further, in general, we expected Performance Avoid goal orientation to negatively influence learner choices during training, affect-based learning outcomes, and training performance. We did not expect to find any significant relationships between Performance Prove goal orientation and these training criteria.

METHOD

Participants

Participants were first-year U. S. Military Academy cadets who took part in a game-based tactics training exercise. The mean age of participants was 18.89 years ($SD = 1.26$ years). Prior to and after the four-day training exercise, cadets were asked to complete online questionnaires for the current research. Completion of the pretraining and posttraining research questionnaires, while encouraged by instructors, was voluntary. The pretraining questionnaire assessed trainees' individual characteristics and pretraining motivation for the game-based training exercise; of the approximately 1000 cadets who participated in the training exercise, 364 cadets completed the pretraining questionnaire. The posttraining questionnaire assessed learner choices and outcomes, including metacognitive activity, time on task, training satisfaction, perceived ease in using the training game interface, perceived team cohesion, and training performance; 80 of the 364 cadets completed the posttraining questionnaire.

Game

The videogame used in the training exercise was *America's Army*, an online PC-based, first-person-perspective game with both single-player and multi-player sections. *America's Army*, created by the Office of Economic and Manpower Analysis at the U. S. Military Academy, was originally developed to serve as a recruiting tool in order to inform potential recruits about what to expect during basic training and about Army core values, history, and Army background. The distribution of *America's Army* has been extensive, with over four million registered players (Petermeyer, 2004). This game was chosen for this exercise because of its ability to simulate small team environments that require decision making and collaboration skills. Additional information regarding *America's Army* is available at <http://www.americasarmy.com>.

Procedure

Prior to the start of the tactics training exercise, the instructor provided the Web address of the questionnaires and informed the cadets of the opportunity to participate in this research. Cadets were provided with an introduction to the questionnaires and promised confidentiality of their responses. Interested cadets completed the questionnaires on their own time.

During the four-day training exercise, cadets played the computer game online during their own time, at a location of their preference. First, the cadets completed a “basic training” single-player section, where they learned how to play the game. This section contained four segments: a) marksmanship training, b) an obstacle course, c) weapons familiarization, and d) a MOUT (military operations in urban terrain) training mission. In the marksmanship segment, cadets practiced using a computer mouse to shoot a rifle. Practice and qualification rounds were repeated until the cadet qualified with his/her weapon (at least 23 out of 40 targets with 40 rounds of ammunition). In the second segment, the obstacle course, cadets completed a course which includes obstacles such as climbing over a wall, running over a balance beam, and low crawling under barbed wire. Cadets repeated the obstacle course until they bettered the time requirement of 90 seconds. In the weapons familiarization segment, cadets practiced using a computer mouse to operate four different weapons including a machine gun, rifle with a grenade launcher, fragmentation grenade, and smoke grenade. Cadets were not required to meet qualification standards with these weapons. In the final segment, MOUT training, cadets navigated through a building and several tunnels while being introduced to and practicing basic “rules of engagement” (i.e., shooting at stationary silhouettes of “hostile” targets while not firing at the silhouettes of “noncombatant” targets). This section required the use of shooting and movement skills introduced in the prior three sections. Cadets repeated the MOUT training exercise until they achieved a target score (based on a combination of shooting hostile targets, not shooting noncombatant targets, and completing the exercise quickly).

Once the basic training section had been completed, cadets were eligible to play the multi-player section of the game. In the multi-player section, cadets were placed into small teams and engaged in collaborative missions. No minimum or maximum limit of missions was set. Team membership was not fixed; instead, membership could vary across collaborative missions depending on which cadets were currently online engaging in the game. In the mission, a team’s goal was either to attack or to defend a radio tower. Regardless of the team’s goal within a given mission, cadets took the perspective of a U.S. Soldier, while the opposing team was depicted as the enemy.

The multi-player section of *America’s Army* represents a distributed, online environment because all team members engage in the same mission during “real” time. However, each team member plays the game on an individual computer, in a different physical location. Team members interact in terms of observing each other’s actions during the “real time” mission and via written communication using an online chat feature built into the game interface.

After the completion of the training exercise, the posttraining questionnaire was posted online. Cadets who completed the pretraining questionnaire were provided with the opportunity to receive a reminder email for this posttraining questionnaire. Interested cadets provided the researchers with an email address to which a reminder was sent.

Measures Prior to Training

Overall videogame experience. Overall game experience was assessed using one item adopted from Orvis et al. (2005), “In the past year, how frequently have you played videogames?” Possible responses ranged from 0 (never) to 5 (very frequently).

Specific videogame experience. Prior game experience with specific games was assessed using a nine-item scale adopted from Orvis et al. (2005). Cadets were asked to note how frequently they played a specific type of videogame, using a 6-point Likert scale ranging from 0 (never) to 5 (very frequently). The nine types of specific game experience assessed were: a) first-person-perspective (e.g., Battlefield 1942, James Bond 007, Medal of Honor); b) flight simulators (e.g., Microsoft Flight Simulator, Lock On: Modern Air Combat); c) massively multi-player online games (e.g., EverQuest, Ultima Online); d) sports/racing (e.g., Madden NFL 2005; Tony Hawk Underground); e) military command/strategy (e.g., Rome, Axis & Allies, Rise of Nations); f) fighting (e.g., WWE Smackdown, Mortal Kombat Deception); g) life/business simulations (e.g., The Sims, Tycoon); h) fantasy/adventure (e.g., Myst IV, Revelation, Syberia 2); and i) puzzles/card games/board games (e.g., Minesweeper, Solitaire, Chess). In addition, participants were asked to indicate the extent to which they had previously played *America's Army*.

Videogame self-efficacy. Videogame self-efficacy was assessed using two items consisting of "I am certain I will be successful at most videogames I try to play" and "I am confident in my ability to play videogames." Possible responses ranged from 1 (strongly disagree) to 5 (strongly agree). The coefficient alpha for this scale was .92.

Goal orientation. Goal orientation was assessed using a 13-item scale adapted from Vandewalle (1997). Five items assessed a trainee's Learning goal orientation. An example item is "I often look for opportunities to develop new knowledge and skills." Performance Avoid goal orientation was assessed with four items; an example item is "I would avoid taking on a new task if there was a chance that I would appear rather incompetent to others." Performance Prove goal orientation was assessed with four items; an example item is "I prefer to work on tasks/assignments where I can prove my ability to others." Possible responses ranged from 1 (strongly disagree) to 5 (strongly agree). The coefficient alpha for Learning goal orientation, Performance Avoid goal orientation, and Performance Prove goal orientation were .85, .82, and .78, respectively. All items of these scales are provided in Appendix A.

Pretraining motivation. Pretraining motivation for the game-based training program was assessed using a five-item scale adapted from Noe and Schmitt (1986). Items were augmented slightly to fit the game environment. Sample items include "I am motivated to learn the information/skills emphasized in the America's Army game" and "I plan to exert a lot of mental effort to do well in the multi-player missions of this game." Possible responses ranged from 1 (strongly disagree) to 5 (strongly agree). The coefficient alpha for this scale was .87. All items of this scale are provided in Appendix A.

Measures Completed After Training

Metacognitive activity. Metacognitive activity was assessed using an eight-item scale adapted from Schmidt and Ford (2003). Items were augmented slightly to fit the game environment. Sample items include "When I practiced a new skill presented in the game, I monitored how well I was learning its requirements" and "I thought about how well my tactics for playing the game were working." Possible responses ranged from 1 (strongly disagree) to 5

(strongly agree). The coefficient alpha for this scale was .89. All items of this scale are provided in Appendix A.

Time on task. Participants were asked to indicate the total number of hours spent playing the game during the four days allotted for this training exercise. We believe this reflects a trainee's motivation to continue training, as this videogame-based training represents a self-regulated voluntary training environment.

Satisfaction with training. Satisfaction with the training experience was assessed using a three-item scale modified from Orvis et al. (2005). An example item is "I was satisfied with the experience of using the America's Army game." Possible responses ranged from 1 (strongly disagree) to 5 (strongly agree). The coefficient alpha for this scale was .90. All items of this scale are provided in Appendix A.

Ease in using game interface. Ease in using the game interface was assessed with three items from Orvis et al. (2005). The items include "How easy/difficult was it to learn how to use America's Army game?," "How easy/difficult was it to use the menu system?" (1 = very easy to 5 = very difficult), and "How comfortable did you feel using the system?" (1 = very comfortable to 5 = very uncomfortable).¹ The coefficient alpha for this scale was .83.

Team cohesion. A trainee's perception of the cohesion among his/her team members was assessed using a nine-item scale adapted from Craig and Kelly (1999). Items were augmented slightly to fit the game environment. Sample items include "To what extent was your team engaged in the multi-player missions of the America's Army game?" and "To what extent did members of your team like being a part of this team?" Because team membership varied across missions played, trainees were asked to respond to these items with respect to the most successful team in which they were a team member. Possible responses ranged from 1 (not at all) to 5 (great extent). The coefficient alpha for this scale was .92. All items of this scale are provided in Appendix A.

Training performance. Training game performance was operationalized at the team level as the proportion of multi-player missions the trainee won out of the total number of missions completed. Cadets were asked to indicate the total number of multi-player missions completed, as well as the number of missions they won and lost.

Perceived transfer of videogaming skills. To enhance our understanding of the influence of videogame experience/practice, cadets were posed a few additional questions. First, cadets were asked to address how helpful their previous overall videogame experience was in preparing them to perform the five skills used during the multi-player section of *America's Army*. The five specific skills included a) using keyboard and mouse to control character, b) using the weapons, c) interacting with team members, d) using appropriate combat tactics, and e) keeping up with the pace of the game. Possible responses ranged from 1 (not helpful at all) to 5 (very helpful). Second, cadets were asked to address how helpful the single-player sections of *America's Army* were in preparing them to perform these five different skills.

¹ These items were reverse coded for the statistical analyses so that higher values reflected greater ease in using the interface.

RESULTS

Descriptive Statistics

Means, standard deviations and intercorrelations of the variables are displayed in Table 1.

Videogame Experience

Overall videogame experience. Results indicate that there is a wide range of prior videogame experience across the participants in this sample, with 12% of cadets reporting they had no experience playing videogames in the prior year and 48% reporting they had limited videogame experience. Prior overall videogame experience significantly predicted pretraining motivation ($r = .32, p < .01$) and most of the examined learner choices/outcomes. Specifically, frequency in playing videogames was positively related to metacognitive strategies utilized during training ($r = .27, p < .05$), time on task ($r = .32, p < .05$), satisfaction with the training game experience ($r = .23, p < .05$), ease in using the game interface ($r = .25, p < .05$), and training performance ($r = .26, p < .05$). The relationship between videogame experience and cohesion with one's team members approached significance ($r = .20, p < .10$). Figure 1 displays the relationships between overall videogame experience and the learner choices/outcomes, with videogame experience dichotomized at the mean ($M = 2.13$). The error bars in Figure 1 represent standard error of the mean.

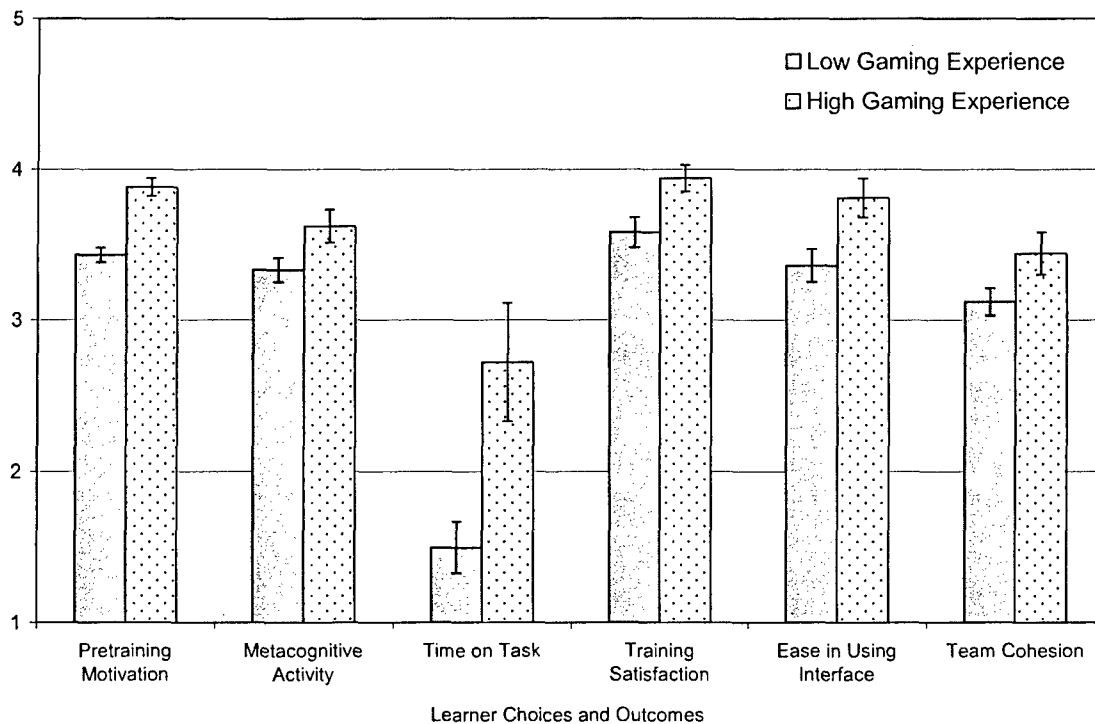


Figure 1. Relationships between overall videogame experience and learner choices/outcomes

Table 1. Means, Standard Deviations, and Intercorrelations of Variables

Variable	<i>N</i>	<i>M</i>	<i>SD</i>	1	2	3	4	5	6	7	8	9	10
1. Overall gaming experience	364	2.13	1.43	--									
2. Relevant gaming experience	364	1.66	1.24	.69**	--								
3. First-person-perspective	363	2.51	1.70	.68**	.90**	--							
4. Simulators	363	.75	1.14	.24**	.37**	.35**	--						
5. Online multi-player	361	.80	1.35	.39**	.36**	.36**	.24**	--					
6. Sports/Racing	364	1.95	1.73	.39**	.48**	.51**	.24**	.22**	--				
7. Command/Strategy	362	1.92	1.87	.51**	.58**	.54**	.30**	.44**	.24**	--			
8. Fighting	362	1.01	1.30	.38**	.36**	.36**	.28**	.34**	.39**	.33**	--		
9. Life/Business Simulations	362	.83	1.11	.26**	.29**	.28**	.22**	.41**	.37**	.35**	.27**	--	
10. Fantasy	359	.91	1.39	.34**	.28**	.31**	.32**	.37**	.27**	.40**	.58**	.35**	--
11. Puzzles	363	1.69	1.54	.14**	.21**	.25**	.16**	.10 ⁺	.25**	.21**	.25**	.29**	.22**
12. America's Army	364	.82	1.21	.44**	.79**	.43**	.27**	.23**	.26**	.42**	.22**	.21**	.15**
13. Videogame self-efficacy	364	3.78	1.14	.59**	.60**	.65**	.24**	.30**	.37**	.51**	.28**	.22**	.32**
14. Learning goal orientation	364	3.82	.56	.04	.18**	.17**	.07	.00	.02	.11 ⁺	.00	-.02	.02
15. Performance Avoid GO	364	2.72	.71	-.01	-.04	-.06	-.05	-.01	.03	-.07	-.05	.02	-.09 ⁺
16. Performance Prove GO	364	3.34	.68	.08	.14**	.11 ⁺	.08	.02	.16**	-.01	.09	.09 ⁺	.05
17. Pretraining motivation	362	3.61	.77	.32**	.33**	.29**	.15**	.17**	.14**	.22**	.13 ⁺	.12 ⁺	.10 ⁺
18. Metacognitive activity	80	3.46	.59	.27 ⁺	.39**	.39**	.21 ⁺	.20 ⁺	.23 ⁺	.30**	.17	.12	.27 ⁺
19. Time on task	54	2.11	1.68	.32 ⁺	.32 ⁺	.26 ⁺	.28 ⁺	-.01	-.29 ⁺	.14	-.26 ⁺	-.09	.07
20. Training satisfaction	80	3.74	.64	.23 ⁺	.42**	.39**	.38**	.16	.11	.28 ⁺	.14	.17	.19 ⁺
21. Ease in using interface	80	3.57	.78	.25 ⁺	.46**	.48**	.30**	.17	.22 ⁺	.40**	.05	.13	.17
22. Team cohesion	75	3.27	.71	.20 ⁺	.41**	.33**	.15	.20 ⁺	.12	.38**	.04	.08	.30 ⁺
23. Training performance	65	37.1	38.4	.26 ⁺	.33**	.24 ⁺	.15	.22 ⁺	.17	.27 ⁺	.25 ⁺	.09	.29 ⁺

Note. All variables were measured on a 1-5 scale except overall and relevant gaming experience (measured on a 0-5 scale), time on task (measured in hours) and training performance (measured as percent of missions won out of total completed). ⁺ $p < .10$. * $p < .05$. ** $p < .01$ (two-tailed).

Table 1. (continued)

Variable	11	12	13	14	15	16	17	18	19	20	21	22	23
1. Overall gaming experience													
2. Relevant gaming experience													
3. First-person-perspective													
4. Simulators													
5. Online multi-player													
6. Sports/Racing													
7. Command/Strategy													
8. Fighting													
9. Life/Business Simulations													
10. Fantasy													
11. Puzzles	--												
12. America's Army	.06	--											
13. Videogame self-efficacy	.11*	.32**	--										
14. Learning goal orientation	.06	.13*	.22**	--									
15. Performance Avoid GO	-.12*	.00	-.02	-.11*	--								
16. Performance Prove GO	.04	.12*	.14**	.40**	.40**	--							
17. Pretraining motivation	.11*	.27**	.38**	.41**	.15**	.32**	--						
18. Metacognitive activity	.06	.26*	.18	.47**	-.05	.18	.33**	--					
19. Time on task	-.02	.30*	.26+	.03	-.23+	-.22	.07	.12	--				
20. Training satisfaction	.17	.32**	.35**	.44**	-.18	.27*	.30**	.63**	.25+	--			
21. Ease in using interface	.20+	.27*	.45**	.16	-.26*	.03	.16	.14	.26*	.35**	--		
22. Team cohesion	.10	.38**	.11	.15	.06	.09	.15	.57**	.26+	.36**	.57**	--	
23. Training performance	.20	.36**	.29*	-.03	.05	.07	.04	.11	.17	.06	.11	.17	--

Specific videogame experience. The role of prior experience with *specific* game types on learner choices/outcomes was examined. Seven regression analyses were conducted, where each of the seven criteria (pretraining motivation, metacognitive activity, time on task, training satisfaction, ease in using the game interface, team cohesion, and training performance) were regressed onto the specific types of game experiences (see Table 2). Generally, results indicate that prior experiences relevant to the videogame used in the training were significant predictors. Specifically, previous experience with the *America's Army* game was a unique predictor for four of the examined criteria (i.e., pretraining motivation, time on task, team cohesion, and training performance). Prior experience with other first-person-perspective games was also a significant predictor of most of the criteria, including pretraining motivation, time on task, training satisfaction, and ease in using the game interface; it approached significance for metacognitive activity. Experience using other types of specific games which did not share several similar characteristics to the current training game, such as puzzles/card games/board games, life/business simulations, and massively multi-player online games, were not predictive of any of the examined criteria. Prior gaming experience with flight simulators was found to predict time on task and training satisfaction. Prior experience with fighting games was found to negatively predict several of the learner choices/outcomes (i.e., time on task, ease in using the game interface, and team cohesion). In summary, consistent with the *Year 1* findings, these results suggest that only experience with relevant videogames positively predicts subsequent learner choices/outcomes in a game-based training environment. The game experiences most relevant to the training game used in this research are prior experience with *America's Army* and other first-person-perspective games.

Perceived transfer of videogaming skills. As a means for further enhancing our understanding of the role of prior videogame experience/practice with games, participants were asked a few additional questions. Trainees were asked to report how helpful their previous overall videogame experience was in preparing them to perform five different skills used during the multi-player section of *America's Army* (e.g., using keyboard and mouse to control character, using the weapons, using appropriate combat tactics, interacting with team members, and keeping up with the pace of the game). Trainees reported that their prior gaming experience was helpful in preparing for the multi-player section. On a scale ranging from not helpful at all (1) to very helpful (5), the mean helpfulness rating across the five skills ranged from 3.56 to 4.05. (Table 3 provides the mean helpfulness rating/standard deviation for each skill.) Trainees were also asked to report how helpful the single-player sections of *America's Army* were in preparing them to perform the skills used during the multi-player section. On average, trainees reported that the single-player section was moderately helpful in preparing for the multi-player section. The mean helpfulness rating across the five skills ranged from 3.12 to 3.65. This suggests that trainees perceive that their prior videogame experience and/or practice with the particular game used for training was beneficial to their performance in the training game.

Table 2. Regression of Specific Videogame Experiences Predicting Learner Choices/Outcomes.

Variable	Pretraining Motivation			Metacognitive Activity			Time on Task			Satisfaction			Ease Using Interface			Cohesion			Training Performance		
	B	SEB	β	B	SEB	β	B	SEB	β	B	SEB	β	B	SEB	β	B	SEB	β	B	SEB	β
America's Army	.11	.04	.17**	.05	.06	.10	.38	.16	.29*	.09	.07	.17	.02	.07	.04	.17	.07	.29*	10.23	4.58	.32*
First-person-perspective	.08	.03	.17*	.10	.06	.27*	.46	.14	.48**	.12	.06	.30*	.16	.07	.35*	.05	.06	.13	-1.09	3.98	-.05
Simulators	.02	.04	.03	.02	.07	.04	.37	.16	.26*	.15	.07	.26*	.10	.08	.14	-.02	.07	-.04	-.91	4.68	-.03
Fantasy	-.02	.04	-.03	.09	.06	.20	.34	.16	.29*	.03	.07	.06	.04	.07	.08	.18	.07	.36*	5.48	4.53	.20
Command/Strategy	.01	.03	.03	.02	.05	.06	-.10	.12	-.11	-.01	.05	-.02	.09	.06	.21	.07	.05	.18	1.19	3.43	.06
Sports/Racing	-.01	.03	-.02	.02	.05	.06	-.48	.12	-.51**	-.06	.05	-.16	.02	.06	.04	.00	.05	.00	.92	3.49	.04
Fighting	.01	.04	.01	-.04	.07	-.10	-.58	.17	-.47**	-.03	.07	-.06	-.15	.08	-.25*	-.16	.07	-.31*	.82	4.81	.03
Online multi-player	.04	.04	.07	.01	.06	.02	-.09	.15	-.07	-.02	.06	-.04	-.02	.07	-.03	.02	.07	.04	2.84	4.28	.10
Life/Business Simulations	-.01	.04	-.01	-.03	.07	-.06	-.10	.18	-.07	.03	.07	.05	-.05	.09	-.07	-.09	.08	-.15	-5.29	5.21	-.15
Puzzles	.03	.03	.05	-.02	.05	-.05	.03	.12	.03	.03	.05	.08	.05	.06	.10	.02	.05	.05	3.90	3.38	.15

Note. $R^2 = .12^{**}$, .20, and .56** , .27* , .32* , .31* , and .22, for pretraining motivation, metacognitive activity, time on task, training satisfaction, ease in using interface, team cohesion, and training performance, respectively. $N = 355$, 77, 51, 77, 77, 72, and 62, for each criterion, respectively. + $p < .10$. * $p < .05$. ** $p < .01$.

Table 3. *Perceived Helpfulness of Prior Videogame Experience/Practice*

Skills	Prior Videogame Experience		Single-Player Section <i>America's Army</i>	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Using keyboard/mouse to control character	4.03	1.01	3.58	.90
Using the weapons	4.05	.96	3.65	.86
Using appropriate combat tactics	3.56	1.09	3.23	1.01
Interacting with team members	3.58	1.00	3.12	1.05
Keeping up with pace of the game	3.82	.99	3.30	1.00

Videogame Self-Efficacy and Goal Orientation

The impact of trainees' self-efficacy and goal orientation on pretraining motivation, as well as on several learner choices and outcomes, was assessed using hierarchical regression. For each criterion, a hierarchical regression analysis was conducted with prior relevant videogame experience in Step 1, videogame self-efficacy in Step 2, and the three types of goal orientation in Step 3. Prior relevant videogame experience (i.e., a mean composite of first-person-perspective and *America's Army* experience) was entered in the first step because our *Year 1* findings demonstrated that this trainee characteristic significantly predicts learner choices/outcomes of videogame-based training environments (Orvis et al., 2005). We entered videogame self-efficacy in Step 2 because in *Year 1* a similar type of self-efficacy, computer self-efficacy, significantly predicted the learner outcomes.

The trainee individual characteristics accounted for 32% of the variance in pretraining motivation ($p < .01$). Specifically, prior relevant videogame experience ($R^2 = .11, p < .01$), videogame self-efficacy ($\Delta R^2 = .05, p < .01$), and goal orientation ($\Delta R^2 = .15, p < .01$) significantly predicted trainees' pretraining motivation. Examination of the individual beta weights indicates support for Learning goal orientation ($\beta = .32, p < .01$) and Performance Avoid goal orientation ($\beta = .16, p < .01$). Performance Prove goal orientation did not significantly predict pretraining motivation.

The trainee individual characteristics, as a set, also significantly predicted the learner choices/outcomes of metacognitive activity ($R^2 = .33, p < .01$), time on task ($R^2 = .20, p < .05$), satisfaction with the game-based training ($R^2 = .36, p < .01$), perceived ease in using the game interface ($R^2 = .32, p < .01$), and perceived team cohesion ($R^2 = .21, p < .01$). Supporting our *Year 1* findings, the results indicate that prior relevant videogame experience explained a substantial amount of variance in all of the learner choices/outcomes: metacognitive activity ($R^2 = .16, p < .01$), time on task ($R^2 = .11, p < .05$), training satisfaction ($R^2 = .18, p < .01$), ease in using the game interface ($R^2 = .21, p < .01$), team cohesion ($R^2 = .17, p < .01$), and training performance ($R^2 = .11, p < .01$). Trainees' self-efficacy for playing videogames explained a significant amount of variance above and beyond videogame experience in ease in using the game interface ($\Delta R^2 = .05, p < .05$).

Finally, trainee goal orientation explained a small to substantial increment of variance in several of the learner choices/outcomes, including metacognitive activity ($\Delta R^2 = .17, p < .01$), training satisfaction ($\Delta R^2 = .17, p < .01$), and ease in using the game interface ($\Delta R^2 = .06, p < .10$). Examination of the individual beta weights indicates that Learning goal orientation positively predicted trainee engagement in metacognitive activity during training ($\beta = .44, p < .01$) and satisfaction with the game-based training ($\beta = .26, p < .05$). Performance Avoid goal orientation negatively predicted one's training satisfaction ($\beta = -.22, p < .05$) and perceived ease in using the game interface ($\beta = -.27, p < .05$). Performance Prove goal orientation, as expected, was generally not predictive of the learner choices/outcomes. However, the beta weight for Performance Prove goal orientation approached significance for training satisfaction ($\beta = .21, p < .10$). Results are presented in Table 4.

DISCUSSION

The purpose of this paper was to investigate the influence of trainee individual attributes on trainee motivation, learner choices, and learning outcomes of videogame-based training environments. This paper extends existing research by demonstrating the importance of a trainee's prior videogame experience, videogame self-efficacy, and goal orientation for the prediction and explanation of these training criteria. Our findings in relation to each trainee characteristic are discussed below, along with practical implications of this research and suggestions for future research.

With regard to prior videogame experience, consistent with our *Year 1* findings, a videogame genre-specific effect was demonstrated in that, in general, only specific prior game experiences that share similar characteristics with the current training game positively predicted the learner choices/outcomes. Trainees with greater experience in playing videogames *relevant* to the current training game environment (i.e., *America's Army* and other first-person-perspective games) were more motivated to train using the training videogame, more comfortable and satisfied using the training videogame, and more cohesive with their teammates during the collaborative components of the training game. More experienced individuals also made more effective learner choices during training than those with less experience. Specifically, they thought more about how well they were learning the information/skills presented during the training game and strategies they could use to improve their level of learning. They also spent more time engaging in the training game than individuals with lower levels of prior relevant game experience. In contrast, prior experiences with specific videogames that do not share similar characteristics with the current training game were generally not positively related to the examined learner choices/outcomes.

It is worth noting that prior gaming experience with flight simulators (e.g., *Falcon*, *Microsoft Flight Simulator*, *Lock On: Modern Air*) was found to positively predict a few of the learner outcomes, including training satisfaction and time on task. In *Year 1* of this research, experience with this game type predicted time on task. It may be that flight simulation games are more closely associated to training well-defined skills (versus solely providing entertainment) as compared to other types of videogames. Another explanation for this relationship may be that *America's Army* and simulations share common game features or characteristics (e.g., first person perspective in a virtual 3D world and pacing of game actions/events) that are critical to

Table 4. Hierarchical Regression of Trainee Characteristics on Learner Choices/Outcomes

Regression step	Pretraining Motivation			Metacognitive Activity			Time on Task			Satisfaction			Ease Using Interface			Cohesion			Training Performance		
	B	SE	β	B	SE	β	B	SE	β	B	SE	β	B	SE	β	B	SE	β	B	SE	β
Step 1																					
Experience	.20	.03	.33**	.19	.05	.39**	.42	.17	.32*	.22	.05	.42**	.28	.06	.46**	.23	.06	.41**	10.48	3.73	.33**
Step 2																					
Experience	.10	.04	.16**	.22	.06	.44**	.35	.22	.27	.18	.07	.33*	.18	.08	.30*	.29	.07	.53**	7.82	4.67	.25*
Self-efficacy	.19	.04	.28**	-.05	.07	-.08	.14	.24	.10	.09	.07	.15	.18	.08	.27*	-.13	.08	-.21	4.83	5.09	.14
Step 3																					
Experience	.09	.03	.14*	.20	.06	.41**	.36	.21	.28*	.15	.06	.29*	.17	.08	.28*	.29	.07	.53**	8.05	4.76	.26*
Self-efficacy	.15	.04	.22**	-.08	.06	-.16	.16	.23	.11	.05	.07	.09	.18	.08	.26*	-.14	.08	-.23*	5.42	5.22	.16
Learning GO	.44	.07	.32**	.47	.12	.44**	.14	.43	.05	.30	.13	.26*	.00	.15	.00	.16	.15	.13	-8.57	9.73	-.12
Performance Avoid GO	.18	.06	.16**	.02	.09	.02	-.24	.34	-.11	-.20	.10	-.22*	-.29	.12	-.27*	.11	.12	.11	1.79	7.69	.03
Performance Prove GO	.09	.06	.08	-.03	.11	-.04	-.60	.39	-.25	.20	.11	.21*	.07	.14	.07	-.05	.14	-.05	2.63	8.73	.05

Note. $R^2 = .11^{**}$ for Step 1; $\Delta R^2 = .05^{**}$ for Step 2; $\Delta R^2 = .15^{**}$ for Step 3, for pretraining motivation. $R^2 = .16^{**}$ for Step 1; $\Delta R^2 = .01$ for Step 2; $\Delta R^2 = .17^{**}$ for Step 3, for metacognitive activity. $R^2 = .11^*$ for Step 1; $\Delta R^2 = .01$ for Step 2; $\Delta R^2 = .09$ for Step 3, for time on task. $R^2 = .18^{**}$ for Step 1; $\Delta R^2 = .02$ for Step 2; $\Delta R^2 = .17^{**}$ for Step 3, for training satisfaction. $R^2 = .21^{**}$ for Step 1; $\Delta R^2 = .05^*$ for Step 2; $\Delta R^2 = .06^+$ for Step 3, for ease in using interface. $R^2 = .17^{**}$ for Step 1; $\Delta R^2 = .03$ for Step 2; $\Delta R^2 = .02$ for Step 3, for team cohesion. $R^2 = .11^{**}$ for Step 1; $\Delta R^2 = .01$ for Step 2; $\Delta R^2 = .02$ for Step 3, for training performance. $N = 361, 79, 53, 79, 79, 74, 79$, and 64, for pretraining motivation, metacognitive activity, time on task, training satisfaction, ease in using interface, team cohesion, and training performance, respectively. $^+ p < .10$. $^* p < .05$. $^{**} p < .01$.

game success. Future research should investigate the relationship among these two game types and the features they share with one another.

Next, self-efficacy for playing videogames was examined for its unique contribution to the prediction of the learner choices/outcomes, after controlling for prior relevant videogame experience. Trainees' self-efficacy for playing videogames explained a significant amount of variance above and beyond videogame experience in pretraining motivation and ease in using the game interface. This indicates that trainees with greater confidence in playing videogames are more motivated and comfortable training in game-based environments than trainees with lower videogame self-efficacy beliefs. Note that when self-efficacy was examined independently as a predictor (i.e., separately from prior experience), this trainee characteristic also significantly predicted satisfaction with the training experience and training performance, and approached significance for time on task. Thus, videogame self-efficacy is influential on several trainee learner choices/outcomes of game-based training environments; however, it does not add substantially to the prediction of most of these criteria beyond trainees' previous experience levels.

Trainees' goal orientation also had a unique impact on the learner choices/outcomes. In other words, knowledge of individuals' goal orientations provided unique information, beyond their prior experience and self-efficacy expectations, to the prediction of their motivation to train and reactions to/experiences with the videogame-based training program.

As expected, Learning goal orientation was positively associated with pretraining motivation, metacognitive activity, and the affect-based learning outcome of training satisfaction. These findings suggest that trainees who approach instructional environments with the purpose of mastering new knowledge/skills are more motivated to train and more satisfied learning in a game-based training environment, as compared to trainees with a low Learning goal orientation. Further, learning-oriented trainees made more effective learner choices during the training. They were more active in monitoring their learning progress and in implementing new strategies to address any difficulties they were experiencing in learning the content of the training game. These findings are consistent with past research indicating that Learning goal orientation positively impacts learner choices/outcomes in other technology-delivered training environments, such as e-learning (e.g., Brown, 2001; Ford et al., 1998; Schmidt & Ford, 2003).

Performance Avoid goal orientation generally exhibited a negative impact on the learner choices/outcomes, including training satisfaction, perceived ease in using the game interface, and time on task. These findings suggest that trainees who seek to avoid receiving negative evaluations from others, or demonstrating low ability/skill levels, are less comfortable and satisfied learning in a game-based training environment. Further, they spend less time engaging in the training game as compared to trainees with a low Performance Avoid goal orientation. Intuitively, these findings make sense as videogame-based training environments (such as the training game used in the present research) often require trainees to work collaboratively in order to be successful in the game and to learn the instructional content. This high level of collaboration during training may increase a high Performance Avoid learner's perceptions concerning his/her likelihood of demonstrating low ability/skill levels; and, therefore, result in negative training-related cognitions and behaviors.

Contrary to our expectations and those of prior work, Performance Avoid goal orientation was found to be positively related to pretraining motivation. To investigate a possible reason for this unexpected finding, we revisited our measurement of pretraining motivation. Several of the items reflected a trainee's motivation to learn the training content, while a few items reflected more of a motivation to succeed/perform well in the training (e.g., "I am motivated to learn the information/skills emphasized in the America's Army game" versus "I will feel upset if I perform poorly in the multi-player missions of this game"). Therefore, we divided the items into two subscales reflecting these two aspects of training motivation. Correlations between these subscales and Performance Avoid goal orientation suggest that high Performance Avoid learners were motivated to perform well in the training game ($r = .18, p < .01$); however, they were not motivated to learn from the training ($r = .07, ns$). In other words, a possible reason underlying their high training motivation was to avoid demonstrating low ability/skill levels or receiving negative evaluations concerning their capabilities, rather than to work hard to actually master the knowledge/skills taught in the game. In contrast, high learning goal-oriented trainees likely valued learning new knowledge/skills ($r = .37, p < .01$). Further, they may have perceived the items reflecting high training performance as a reflection of their substantive knowledge/skill development ($r = .37, p < .01$).

Finally, in general, Performance Prove goal orientation did not significantly predict the learner choices/outcomes in the hierarchical regression analyses. Performance Prove goal orientation did approach significance in its prediction of trainees' satisfaction with the training experience. This finding suggests that trainees who seek to outperform others and demonstrate high ability/skill levels are more satisfied engaging in a game-based training environment than those with a low Performance Prove goal orientation. A possible explanation for this unexpected finding may be that these individuals perceived the highly collaborative nature of the game-based training as an opportunity to demonstrate their competence or outshine other trainees; therefore, they enjoy this type of learning environment. As U.S. Military Academy cadets may not be representative of the general population, future research should investigate if this relationship is replicated with a different sample of trainees.

Implications and Directions for Future Research

This research suggests that the attributes trainees bring to the training environment are important variables to consider when implementing game-based training. A trainee's prior experience, self-efficacy, and goal orientation beliefs contributed value added in terms of understanding when game-based training should succeed in enhancing trainee motivation and other important learner choices/outcomes. The good news is that these attributes are relatively malleable trainee characteristics that can be influenced by instructors or game developers. Based on the present research findings, we provide some specific recommendations for instructors utilizing game-based training and training game developers.

First, we suggest that instructors assess trainees' prior game experiences. By assessing the amount of relevant previous gaming experiences trainees possess, instructors will be able to identify those who lack the prerequisite game experience. In turn, instructors can then provide these trainees with targeted opportunities to gain such beneficial experiences prior to training. For example, if learners are to engage in a first-person-perspective game-based training program

and some learners have little prior experience with this type of videogame, then the instructor would know to give them ample practice time before the learning segment of the training (i.e., when learners are acquiring the new knowledge/skills taught in the game). To facilitate instructors in providing the appropriate amount of preparatory practice for a given learner's needs, training game developers should incorporate a feature within the game that enables the instructor to select the desired amount and content of trainee orientation and practice.

It may be assumed that most junior Soldiers who grew up in the digital age would have a great deal of experience with videogames; and, therefore, additional orientation and practice with videogames would be unnecessary. This assumption does not seem warranted given the experience levels of the participants sampled. In the current sample, 12% of first-year U. S. Military Academy cadets (mean age = 18.89 years) reported they had no prior videogame experience of any kind (i.e., the overall videogame experience measure) and 48% reported they had limited experience. These findings parallel our *Year 1* results, in which 17% of cadets reported they had no experience playing videogames and 44% reported they had limited videogame experience. Further, 16% of cadets reported they have no experience playing first-person-perspective videogames or *America's Army* in the past year and 65% reporting they have limited experience with this type of videogame. Given the number of cadets with little to no experience, providing an orientation or additional practice with relevant games would likely be valuable whenever implementing a game-based training program. Doing so may improve a host of learner choices/outcomes such as trainee motivation, metacognitive activity, length of time devoted to training, and training satisfaction.

When instructors are providing additional practice opportunities with a relevant videogame, it is also likely that trainees will feel more confident in their capability to successfully learn in a training environment which incorporates a comparable game. One way to enhance self-efficacy is to initially provide relatively easy practice sessions. Then, when learners are successful at these practice sessions, provide positive feedback and encouragement. Such feedback could be provided by the instructor or could be built into the videogame content and delivered during game play. These suggestions are supported by Bandura (1977) who proposed that obtaining experiences resulting in successful performance or receiving feedback on one's capabilities are two ways in which to develop positive self-efficacy beliefs.

With respect to goal orientation, while this construct is often characterized as a fairly stable personal trait, the goal orientation literature does suggest that an individual's goal orientation can be shaped by situational factors (e.g., Button et al., 1996; Kozlowski et al., 2001; Schmidt & Ford, 2003; Weissbein & Ford, 2002). For instance, Weissbein and Ford (2002) found that a pretraining intervention was successful at influencing trainees' attributions, such that trainees adopted a more learning goal-oriented perspective while engaging in a training program. Accordingly, we recommend that instructors implementing a game-based training program should emphasize the perspective of learning and acquiring new skills during the game versus the perspective of striving reach a high score or to be the "best" at the game.

The results of the present research suggest several interesting points worth further consideration and additional research. First, we realize that the primary limitation of the present research was that we were unable to measure knowledge or skill-based learning outcomes.

While the learner choices/outcomes examined in this research have been associated with learning in other training contexts, future research is needed to enhance our understanding of the role of trainee characteristics in predicting these more distal criteria in game-based learning environments.

The present research did attempt to measure performance while completing the training, as prior research has shown that a learner's training performance is positively related to knowledge/skill transfer (Ford et al., 1998). We measured training performance as the self-reported proportion of collaborative missions the learner won out of the total number of missions completed. It is important to note that we were unable to capture and assess performance of an individual learner. Instead, this measure captured team-level performance during the missions played. While an individual learner's level of performance may directly contribute to (or correlate with) his/her team's performance, this assumption may not necessarily be the case. This may account for why we found that the trainee characteristics accounted for a smaller proportion of variance in training performance, as compared to the other examined learner choices/outcomes, which could be assessed at the individual-level. We suggest future research incorporate individual-level assessments of game performance and/or of the learner's mastery level of knowledge and skills being taught during the training game.

Another avenue for future research is to examine how trainee characteristics and common features or attributes incorporated in a training game may interact to influence trainees' choices made during the training and learning outcomes. Prior research has demonstrated such attribute-treatment interactions within other types of training environments. For example, trainee characteristics, such as cognitive ability and anxiety, have been found to interact with features/attributes (e.g., structure) of classroom-based instructional environments to influence a learner's level of learning and retention (see Campbell & Kuncel, 2001; Rigney, Munro, & Crook, 1979; Snow, 1989; Snow & Lohman, 1984). We suggest future research investigate such possible interactions in a game-based learning environment and consider whether game features can be altered to better accommodate different types of trainees.

Summary

Desktop simulations and gaming technology have captured the attention of training professionals and educators (Garris et al., 2002) and PC-based videogames are emerging as an increasingly popular training tool in the U. S. Army (Herz & Macedonia, 2002). To date, little research had been directed towards identifying specific individual characteristics of the trainee that may facilitate or impede the effectiveness of videogames as training and development tools. The present research demonstrates that the attributes Soldiers bring to the game-based training environment may influence their motivation to train, as well as several other learner choices and outcomes relevant to this type of learning environment. Specifically, trainees' prior videogame experience, videogame self-efficacy, and goal orientation made significant differential contributions to the prediction of these proximal training criteria. Maximizing these proximal criteria, in turn, should impact Soldiers' overall mastery of the knowledge and skills being trained and ultimately enhance their operational capabilities.

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APPENDIX A

Goal orientation scale

Learning GO (Items 1-5); Performance Avoid GO (Items 6-9); Performance Prove GO (Items 10-13)

Response options: 1 (*strongly agree*) to 5 (*strongly disagree*)

1. I am willing to select a challenging task/assignment that I can learn a lot from.
2. I often look for opportunities to develop new skills and knowledge.
3. I enjoy challenging and difficult tasks at school where I'll learn new skills.
4. For me, development of my ability is important enough to take risks.
5. I prefer to work in situations that require a high level of ability and talent.
6. I would avoid taking on a new task if there was a chance that I would appear rather incompetent to others.
7. Avoiding poor performance is more important to me than learning a new skill.
8. I'm concerned about taking a task/assignment at school if my performance would reveal that I had low ability.
9. I prefer to avoid situations at school where I might perform poorly.
10. I'm concerned that I show that I can perform better than my classmates.
11. I try to figure out what it takes to prove my ability to others at school.
12. I enjoy it when others at school are aware of how well I am doing.
13. I prefer to work on tasks/assignments where I can prove my ability to others.

Satisfaction with training scale

Response options: 1 (*strongly agree*) to 5 (*strongly disagree*)

1. I was satisfied with the experience of using the America's Army game.
2. I was satisfied with the information/skills emphasized in the America's Army game.
3. Playing the America's Army in this training exercise was enjoyable for me.

Pretraining motivation scale

Response options: 1 (*strongly agree*) to 5 (*strongly disagree*)

1. I am motivated to learn the information/skills emphasized in the America's Army game.
2. I will exerted considerable effort to learn the information/skills presented in this game.
3. I am eager to do well in the America's Army multi-player missions I will be playing.
4. I plan to exert a lot of mental effort to do well in the multi-player missions of this game.
5. I will feel upset if I perform poorly in the multi-player missions of this game.

Continued on the following page

Metacognitive activity scale

Response options: 1 (*strongly agree*) to 5 (*strongly disagree*)

1. If I got confused while playing, I made sure I sorted it out before moving on.
2. In order to direct my efforts I thought about the things I needed to do to learn.
3. I tried to determine which things I didn't understand well and adjusted my learning strategies accordingly.
4. When I practiced a new skill presented in the game, I monitored how well I was learning its requirements.
5. I noticed where I made mistakes and focused on improving those areas.
6. I tried to monitor closely the skills where I needed to improve most.
7. I thought about how well my tactics for playing the game were working.
8. I tried to change my strategies for playing the game in order to fit the demands of the mission.

Team cohesion scale

Response options: 1 (*not at all*) to 5 (*to a great extent*)

1. To what extent was your team engaged in the multiplayer missions of the America's Army game?
2. To what extent did your team enjoy working on the America's Army game?
3. To what extent did your team treat the exercise using America's Army game as meaningful and important?
4. To what extent did you expect your team to derive benefits from a successful team performance during America's Army game?
5. To what extent did the members of your team like each other?
6. To what extent was it important that the members of your team got along with one another?
7. To what extent did the members of your team feel similar to one another?
8. To what extent was it important for members of your team to communicate during the mission?
9. To what extent did members of your team like being a part of this team?